STUDY OF THE SUN ROTATION. SPOTTING AND MOVEMENTS

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Abstract

Objects:

- Movement of Sunspots using SOHO data.
- Representation of the movement. Production of models in paper or cardboard to represent the real and projected motions of the spots at different latitudes.
- Calculation of rotation speeds at different solar latitudes.
- Observation of Sunspots. Organisation of observation: methods and details for experimentation in a school context.

The workshop will use pencil and paper followed by computer applications for the rational use of SOHO data in the classroom.

DATA RESEARCH

It is necessary to assemble pictures of the photosphere of the Sun over 1 month. Repeating this work over several months… and even over several years will make you understand better the behaviour of the Sunspots, and so, the rhythm of the Sun's activity.
For that, two methods will be described:

- **Observation *in situ*.** Observe the Sun by projection onto a locating grid graduated in solar coordinates. But, be careful, the Earth also rotates and so the Sun's North-South axis appears to change through the course of the day. It will be easier to record always at the same time.
  Useful equipment: a small reflecting or refracting telescope, binoculars or a "Solarscope" or… any other instrument to get a projected image at least 8 cm in diameter.
- **The selection of SOHO pictures**. The probe daily records pictures of the Sun which are sent online and are stored in the archive.
  http://sohowww.nascom.nasa.gov/data/latestimages.html ; the pictures of the photosphere (intensitygram full disc) come from the MDI instrument.

LOCATION OF THE SUNSPOTS

1. **Select** some spots which can be easily identified and give them a name like: a, b, c... If the cluster is dense, note the centre of the cluster.
2. **Note the coordinates** of each Sunspot, i.e. its latitude and its longitude, with the help of a transparent grid, with a diameter similar to the images of the Sun.

It is possible but difficult to draw yourself… you can find one at: http://solar-center.stanford.edu/images/sungrid-0.gif . You will certainly have to enlarge it to adapt it to the size of your solar images.

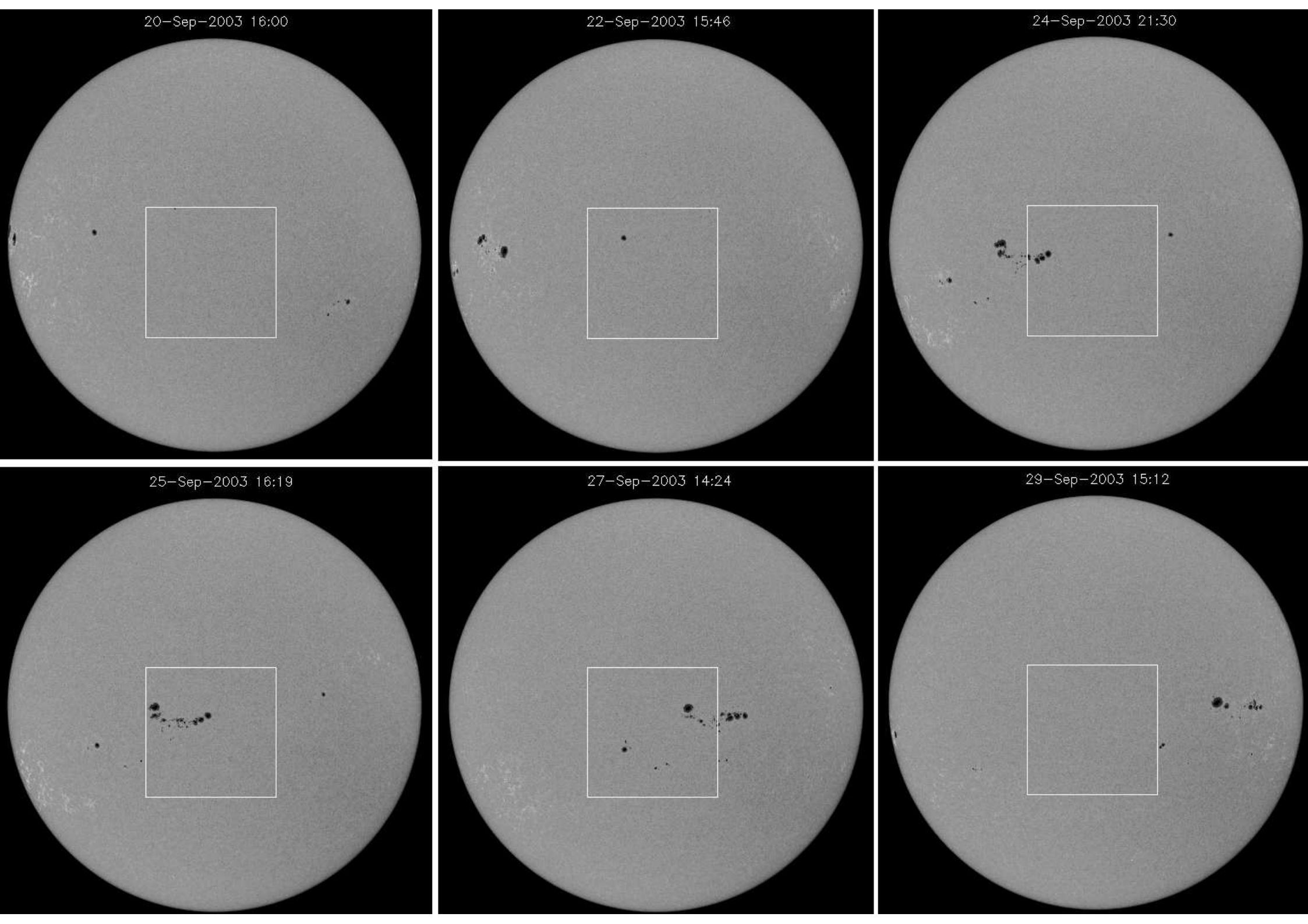
3. **Collect these measurements** in a table, writing the name of the spot, the date and the time.
4. **Locate the spots,** whenever you record, on a same blank solar disc and with a same diameter (one spot per disc).
5. **Note also** the important changes in the aspect of the spots or clusters: shape, size, appearance or disappearance.

COMPORTMENT AND MOVEMENT OF THE SPOTS

- **By analysing the table** (3) and the location on the spot on the individual disc (4), we can evaluate when and where each spot will disappear behind the limb. The movement of the Earth around the Sun (anti-clockwise like the rotation of the Sun), about 1 degree per day, induces a correction of 1%.
- **By comparing the different discs** (4) and notes, we can imagine whether, where and when a spot which disappears on the western limb reappears on the eastern limb.
- **By selecting a few pictures taken by** SOHO at other wavelengths, when a spot disappears behind the limb, we can imagine what happens when a spot disappears.
- What can we say about the movement of the spots located at other latitudes?

ROTATION SPEED OF THE SUN

- **Considering the spots on September 2003** located on the solar equator, determine the duration of a rotation of the solar matter of the equator. To make the evaluation acceptable, we have to calculate the average measurement of several spots.
- **What can we do if the spot appears and disappears in a few days on the disc?** The problem can be solved, whether the spot is on the equator or at higher latitude.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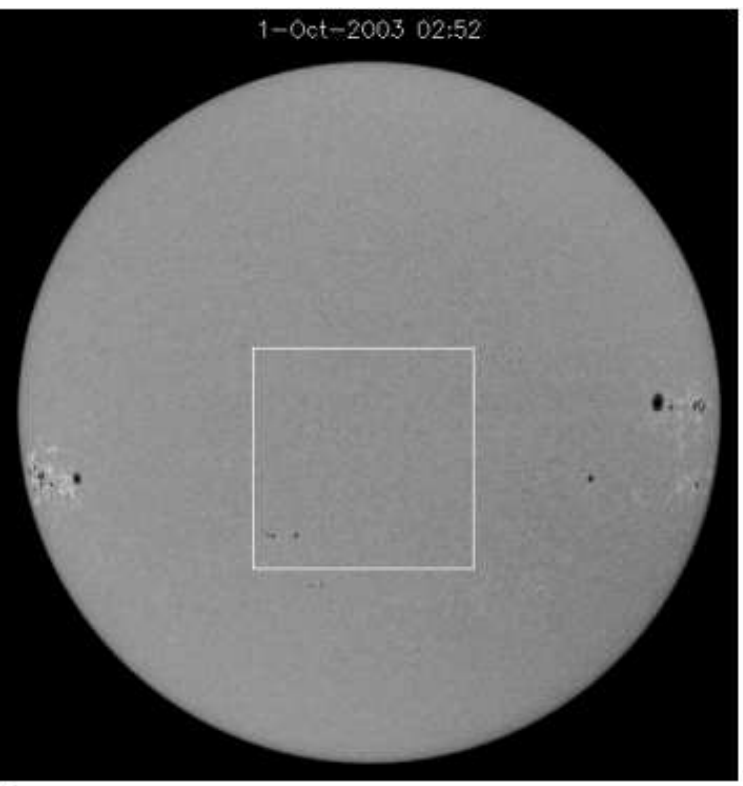
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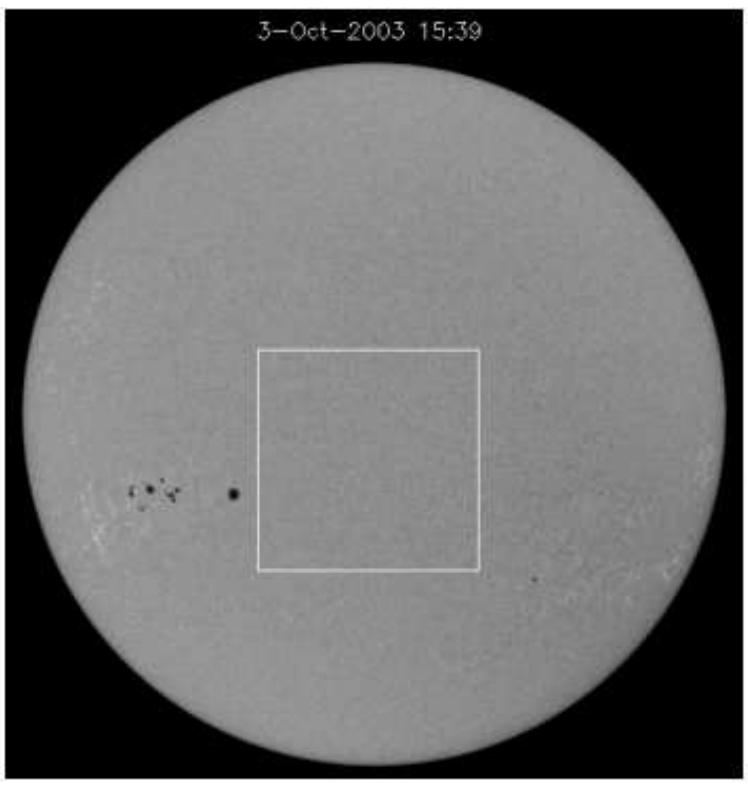
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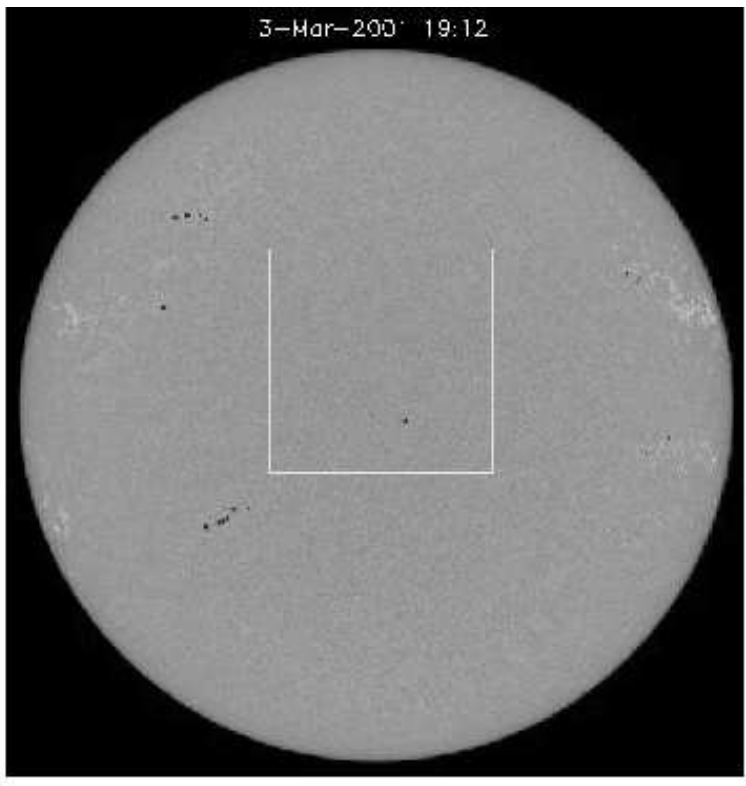
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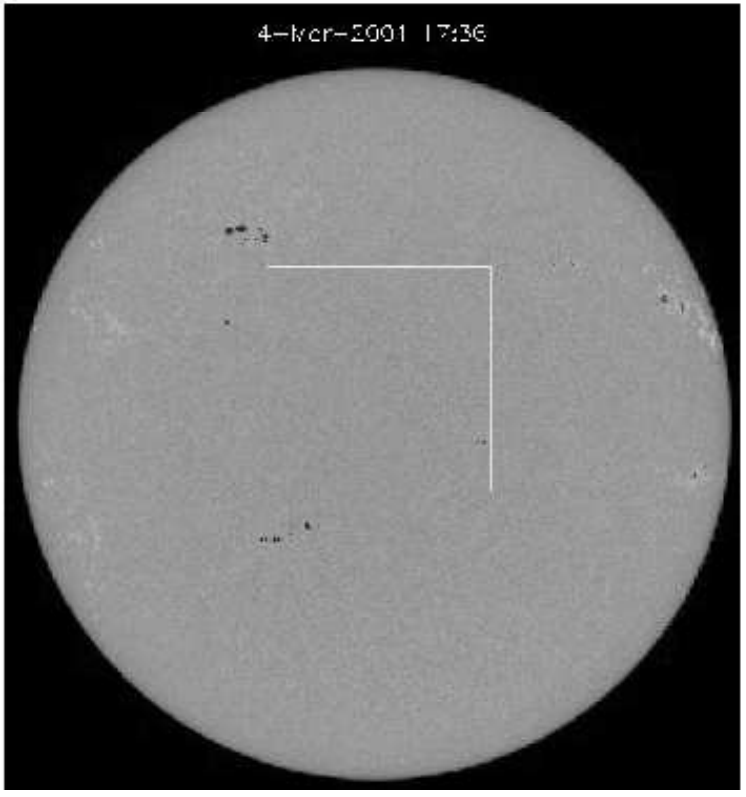
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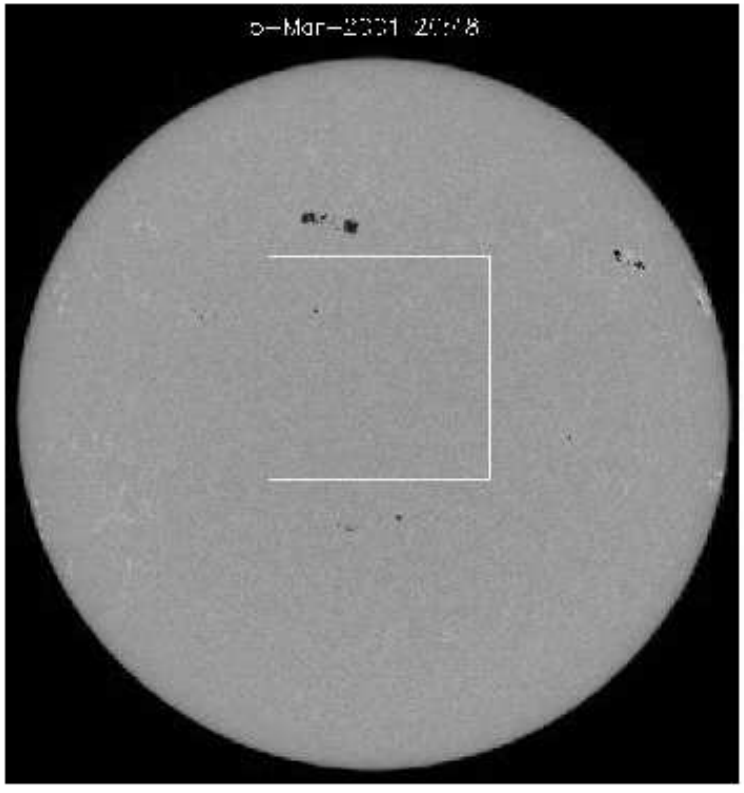
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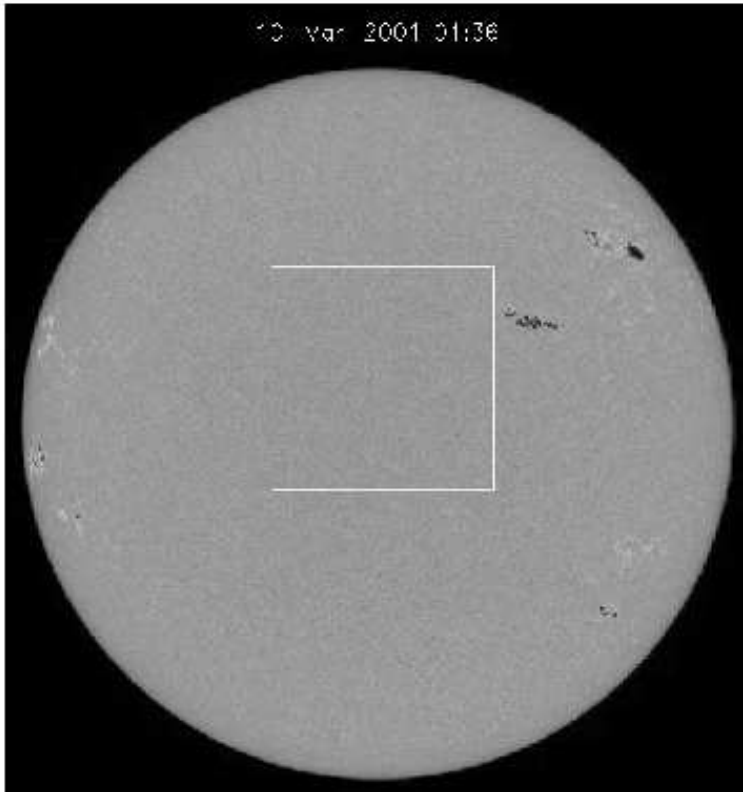
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